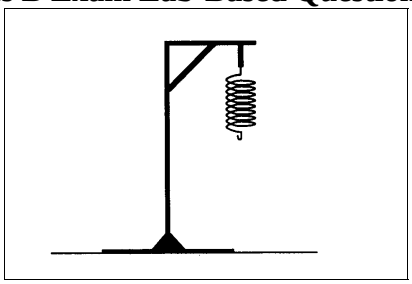
AP Physics B Exam Lab-Based Questions Practice



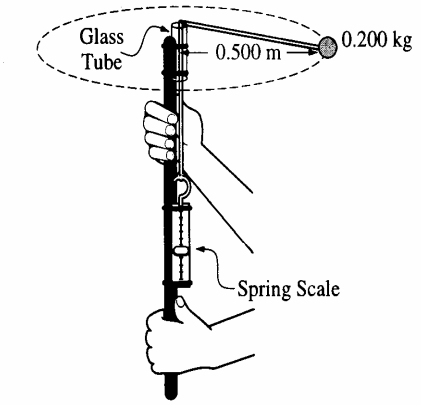
1996B2. (15 points) A spring that can be assumed to be ideal hangs from a stand, as shown above.

a. You wish to determine experimentally the spring constant k of the spring.
   i. What additional, commonly available equipment would you need?
   ii. What measurements would you make?
   iii. How would k be determined from these measurements?

b. Assume that the spring constant is determined to be 500 N/m. A 2.0-kg mass is attached to the lower end of the spring and released from rest. Determine the frequency of oscillation of the mass.

c. Suppose that the spring is now used in a spring scale that is limited to a maximum value of 25 N, but you would like to weigh an object of mass M that weighs more than 25 N. You must use commonly available equipment and the spring scale to determine the weight of the object without breaking the scale.
   i. Draw a clear diagram that shows one way that the equipment you choose could be used with the spring scale to determine the weight of the object,
   ii. Explain how you would make the determination.

1997B2. (15 points) To study circular motion, two students use the hand-held device shown above, which consists of a rod on which a spring scale is attached. A polished glass tube attached at the top serves as a guide for a light cord attached the spring scale. A ball of mass 0.200 kg is attached to the other end of the cord. One student swings the teal around at constant speed in a horizontal circle with a radius of 0.500 m. Assume friction and air resistance al negligible.



Not Necessarily To Scale

a. Explain how the students, by using a timer and the information given above, can determine the speed of the ball as it is revolving.

b. How much work is done by the cord in one revolution? Explain how you arrived at your answer.

c. The speed of the ball is determined to be 3.7 m/s. Assuming that the cord is horizontal as it swings, calculate the expected tension in the cord.

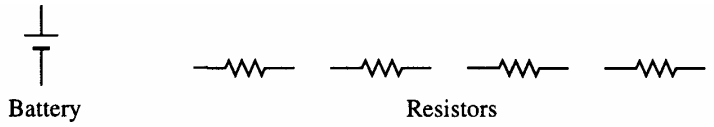
d. The actual tension in the cord as measured by the spring scale is 5.8 N. What is the percent difference between this measured value of the tension and the value calculated in part c. ?

e. The students find that, despite their best efforts, they cannot swing the ball so that the cord remains exactly horizontal.
   i. On the picture of the ball below, draw vectors to represent the forces acting on the ball and identify the force that each vector represents.

   ii. Explain why it is not possible for the ball to swing so that the cord remains exactly horizontal.
   iii. Calculate the angle that the cord makes with the horizontal.

1998B4. (10 points) In the circuit shown above, A, B. C, and D are identical light bulbs. Assume that the battery maintains a constant potential difference between its terminals (i.e., the internal resistance of the battery is assumed to be negligible) and the resistance of each light bulb remains constant.

a. Draw a diagram of the circuit in the box below, using the following symbols to represent the components in your diagram. Label the resistors A, B. C, and D to refer to the corresponding light bulbs.



Draw your diagram in this box only.

b. List the bulbs in order of their brightnesses, from brightest to least bright. If any two or more bulbs have the same brightness, state which ones. Justify your answer.

c. Bulb D is then removed from its socket.
   i. Describe the change in the brightness, if any, of bulb A when bulb D is removed from its socket. Justify your answer.
   ii. Describe the change in the brightness, if any, of bulb B when bulb D is removed from its socket. Justify your answer.

d. i. Is the collision elastic? Justify your answer.

   ii. Briefly explain why there is a minimum in the kinetic energy curve at t = 1.00 s.

1999B6. (10 points) You are given the following equipment for use in the optics experiments in parts (a) and (b).

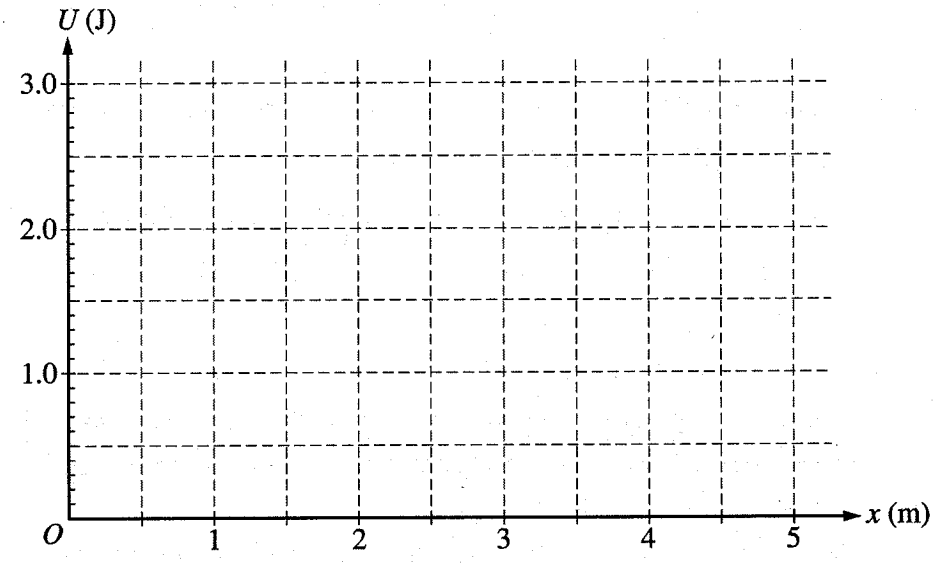
A solid rectangular block made of transparent plastic
A laser that produces a narrow, bright, monochromatic ray of light
A protractor
A meterstick
A diffraction grating of known slit spacing
A white opaque screen

a. Briefly describe the procedure you would use to determine the index of refraction of the plastic. Include a labeled diagram to show the experimental setup. Write down the corresponding equation you would use in your calculation and make sure all the variables in this equation are labeled on your diagram.

b. Since the index of refraction depends on wavelength, you decide you also want to determine the wavelength of your light source. Draw and label a diagram showing the experimental setup. Show the equation(s) you would use in your calculation and identify all the variables in the equation(s). State and justify any assumptions you make.

2002B3. An object of mass 0.5 kg experiences a force that is associated with the potential energy function $U(x) = \frac{4.0}{2.0 + x}$, where U is in joules and x is in meters.

a. On the axes below, sketch the graph of U(x) versus x.



b. Determine the force associated with the potential energy function given above.

c. Suppose that the object is released from rest at the origin. Determine the speed of the particle at x = 2 m.

In the laboratory, you are given a glider of mass 0.50 kg on an air track. The glider is acted on by the force determined in part (b). Your goal is to determine experimentally the validity of your theoretical calculation in part c.

d. From the list below, select the additional equipment you will need from the laboratory to do your experiment by checking the line to the left of each item. If you need more than one of an item, place the number you need on the line.

_____ Meterstick _____ Stopwatch _____ Photogate timer _____String
Spring

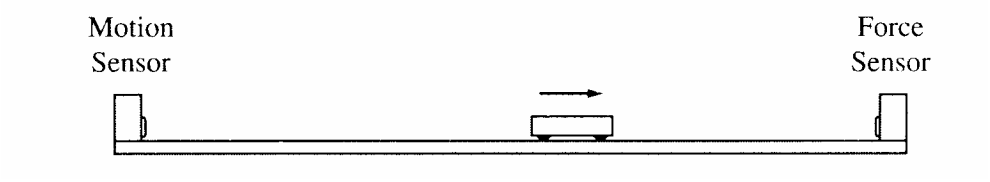
_____ Balance _____ Wood block _____ Set of objects of different masses

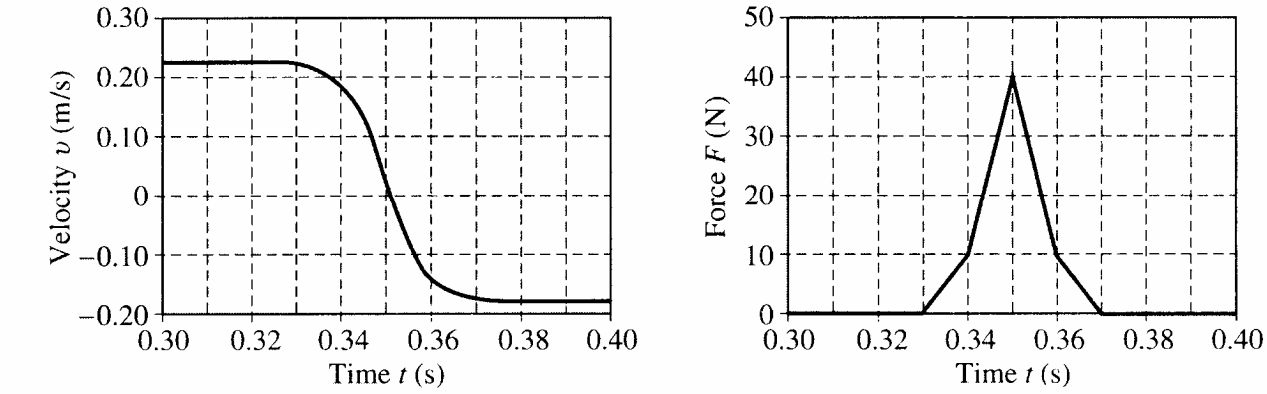
e. Briefly outline the procedure you will use, being explicit about what measurements you need to make in order to determine the speed. You may include a labeled diagram of your setup if it will clarify your procedure.

2001B5. (10 points) A platinum resistor has a resistance that changes with temperature. Values of the resistance were obtained experimentally for several temperatures from 5°C to 30°C only and plotted on the graph above. Design a procedure in which this resistor can be used as a thermometer to measure the temperature of a liquid that is in the 50°C to 75°C range. The resistor can be safely immersed in liquids. Along with the resistor and the container of the liquid of unknown temperature, the following equipment and materials may be used.

Power supply
Ammeter (Note: The ammeter and the voltmeter cannot
Voltmeter be used directly as an ohmmeter.)
Connecting wires
Ice-water bath
Boiling-water bath

a. Sketch a diagram (with labels) to show how equipment is to be connected to make the necessary measurements, and briefly outline the steps to be followed.
b. Discuss what measurements will be taken to determine the temperature of the unknown liquid.
c. Discuss <u>one</u> assumption that must be made regarding equipment or procedure in order to use the method you have described.





2000B1. A motion sensor and a force sensor record the motion of a cart along a track, as shown above. The cart is given a push so that it moves toward the force sensor and then collides with it. The two sensors record the values shown in the following graphs.

a. Determine the cart's average acceleration between t = 0.33 s and t = 0.37 s.

b. Determine the magnitude of the change in the cart's momentum during the collision.

c. Determine the mass of the cart.

d. Determine the energy lost in the collision between the force sensor and the cart.